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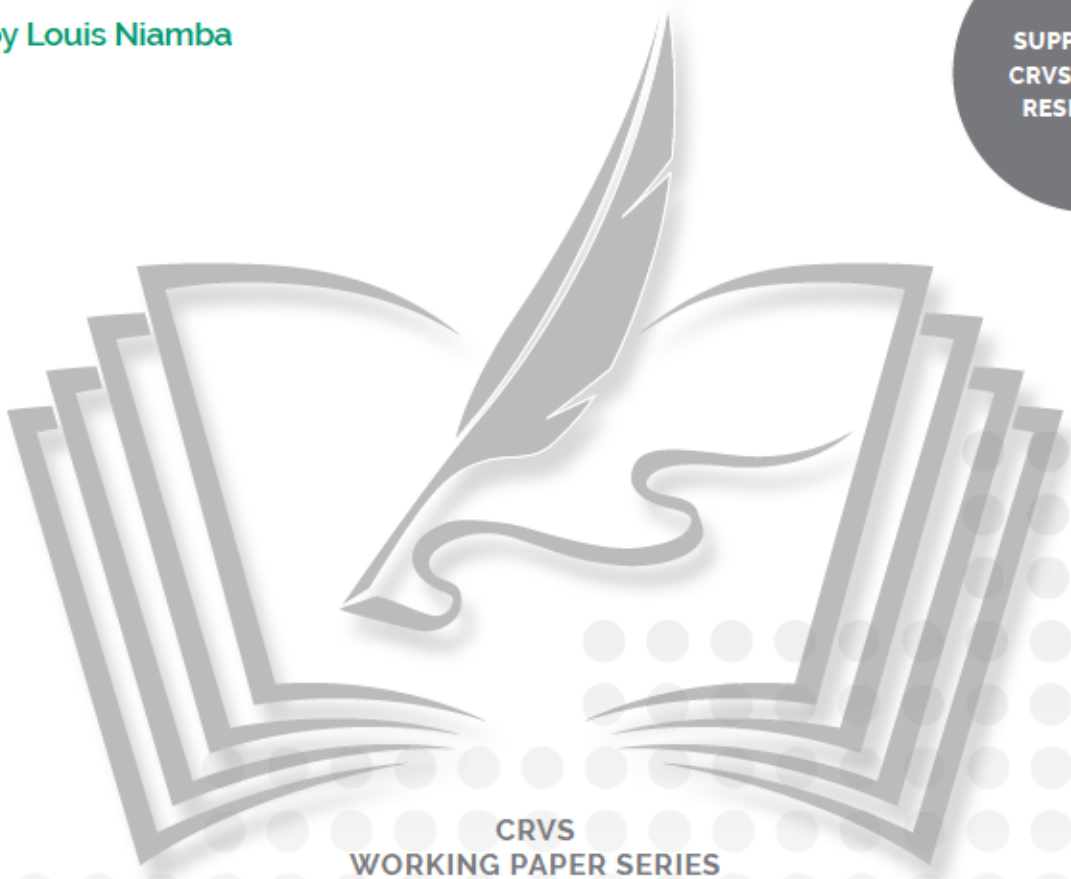
Civil Registration and Vital Statistics (CRVS) Systems in the Face of the **COVID-19 Pandemic**: A Literature Review

by Louis Niamba

SUPPORTING CRVS SYSTEM RESILIENCE



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Executive summary

The coronavirus disease 2019 (COVID-19) pandemic has had and continues to have adverse effects on all industries worldwide, including on the operations of civil registration and vital statistics (CRVS) systems. The universal, compulsory, continuous, permanent, and confidential recording of the occurrence of all vital events is undermined by the various restrictions imposed by governments (quarantines, lockdowns, social and physical distancing measures, workplace closures, transit shutdowns, etc.). The resulting changes in civil registration systems have a definite negative impact on the quantity and quality of civil registrations. Many CRVS systems have considered marriages and divorces to be less important vital events, and a number of countries have suspended their registration. While online registration of births and deaths is an option in developed countries, this is not the case in developing countries because of the poor coverage and quality of internet connections. In total, 9 out of 10 national statistics offices in low- and middle-income countries have experienced a decline in their capacity to meet international data collection requirements, compared with 1 in 2 national statistics offices in high-income countries.

The COVID-19 pandemic has revealed once again that the current functioning of CRVS systems around the world does not make it possible to meet the urgent need for reliable data during times of crisis. The conventional statistical system is poorly adapted to providing real-time information on mortality, even when it mobilizes as it has during the COVID-19 pandemic. All of the literature on this health crisis comes as a call to reflect on the weaknesses of the current CRVS systems to propose solutions for enhanced capabilities to provide reliable vital statistics in real time for informed decision-making. Alternative sources or methods will have to be used if necessary. The most promising solution being considered is the use of mobile data. However, this is not easy in most developing countries where, in addition to the poor coverage and internet connection quality, the quality of mobile phone services is much less reliable. Therefore, considerable investment is required in strengthening CRVS systems in these countries to improve their resilience to natural disasters and other crises.

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List of acronyms

COVID-19	Coronavirus disease 2019
CRVS	Civil registration and vital statistics
Ined	French Institute for Demographic Studies
SARS-CoV-2	Severe acute respiratory syndrome coronavirus 2
SI-VIC	Système d'information pour le suivi des victimes d'attentats et de situations sanitaires exceptionnelles [Information system for monitoring victims of attacks and exceptional health situations]
UNECA	United Nations Economic Commission for Africa
UNESCAP	United Nations Economic and Social Commission for Asia and the Pacific
WHO	World Health Organization

Introduction

The continuous, permanent, and compulsory recording in civil registers of the date and characteristics of deaths, including their causes, is essential for confirming a person's legal identity and providing governments with important information on national mortality and morbidity. However, since the November 2019 outbreak of the coronavirus disease 2019 (COVID-19) in Wuhan in mainland China and its subsequent spread to all other continents, various governments have imposed quarantines, lockdowns of varying severity depending on the country, and social and physical distancing measures on their populations and cities. These measures have resulted in the interruption of almost all daily activities in most countries. This is attributable to factors such as the closure of workplaces, the shutdown of transit and schools, and enormous strain on health systems.

Statistical production operations are no exception. According to figures from the United Nations Statistics Division of the Department of Economic and Social Affairs, as of 6 June 2020, 65 percent of national statistics offices were or had been partially or fully closed, 90 percent had asked their staff to work from home, and 96 percent had partially or fully stopped face-to-face data collection (Fu and Schweinfest 2020). The COVID-19 pandemic has had and is having a significant impact on statistical operations worldwide, including the activities of civil registration and vital statistics (CRVS) systems (Fu and Schweinfest 2020). For example, many institutes have been unable to carry out activities such as cross-sectional surveys, censuses, and civil registration as a result of factors including restrictions on people's mobility, refusals to respond, and the closure of a number of registration and statistical production facilities (Fu and Schweinfest 2020; UNSD 2020).

The main objective of this work is to conduct a literature review of CRVS systems in the face of the COVID-19 pandemic. Given the recent nature of the pandemic, and therefore the limited scientific production on the subject, we consulted all potential search engines for literature on the topic. Thus, we conducted searches on Google, Google Scholar, the Social Science Research Network (SSRN), and social networks (Twitter, Facebook, LinkedIn, etc.) using keywords such as COVID-19 and civil registration/COVID-19 and *état civil* and COVID-19 impact and civil registration. These searches allowed us to find a few scientific articles on the topic on Google Scholar and SSRN. On Google, we were able to access publications from international organizations concerned with issues related to COVID-19 and civil registration, such as the World Health Organization (WHO), the United Nations Economic Commission for Africa (UNECA), the Africa Programme for Accelerated Improvement of Civil Registration and Vital Statistics (APAI-CRVS), the United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP), and the United Nations Statistics Division (UNSD). We also participated in a number of webinars on the subject organized by several international organizations, including UNECA, UNESCAP, and Bloomberg Philanthropies. We were able to collect some links to these webinars that helped us broaden this literature review. The members of the Technical Working Group set up by the Centre of Excellence for CRVS Systems at the International Development Research Centre (IDRC) also contributed to reflections on the relationship between COVID-19 and civil registration. Some members provided us with relevant publications on the subject.

This literature review is structured around six main points, in addition to the introduction and conclusion. We will begin by outlining the magnitude of the pandemic and the mortality it is causing around the world. Second, we will present the effects of COVID-19 on the registration of births, marriages, deaths, and causes of death. The third point of this literature review will examine the resilience of CRVS systems during this health crisis. The fourth part of our work will focus on alternative solutions to the inability of CRVS systems to provide accurate and complete information in real time. The fifth point will be devoted to the outlook for CRVS systems after the pandemic. In the final section, we will discuss gender and COVID-19.

Brief overview of mortality related to COVID-19

According to official WHO figures, as of 5 October 2020, at 12:26 Universal Time, there were 35,027,546 cases of COVID-19 infection and a total of 1,034,837 deaths across the globe. As we know, different parts of the world are disproportionately affected by the COVID-19 pandemic (WHO 2020):

- The Americas remain the region with the highest number of deaths at 17,101,686 cases of infection and 570,746 deaths;
- Europe immediately follows with 6,187,384 cases of infection and 240,148 deaths;
- Southeast Asia follows with 7,418,537 cases of infection and 120,237 deaths;
- The Eastern Mediterranean ranks fourth with 2,486,594 cases of infection and 63,624 deaths;
- Africa is the second least-affected region in terms of mortality with 1,202,973 cases and 26,334 deaths; and
- The Western Pacific was the least-affected region, with a total of 629,631 cases of infection and 13,735 deaths.

Figure 1: Cases of infection by region as of 5 October 2020.

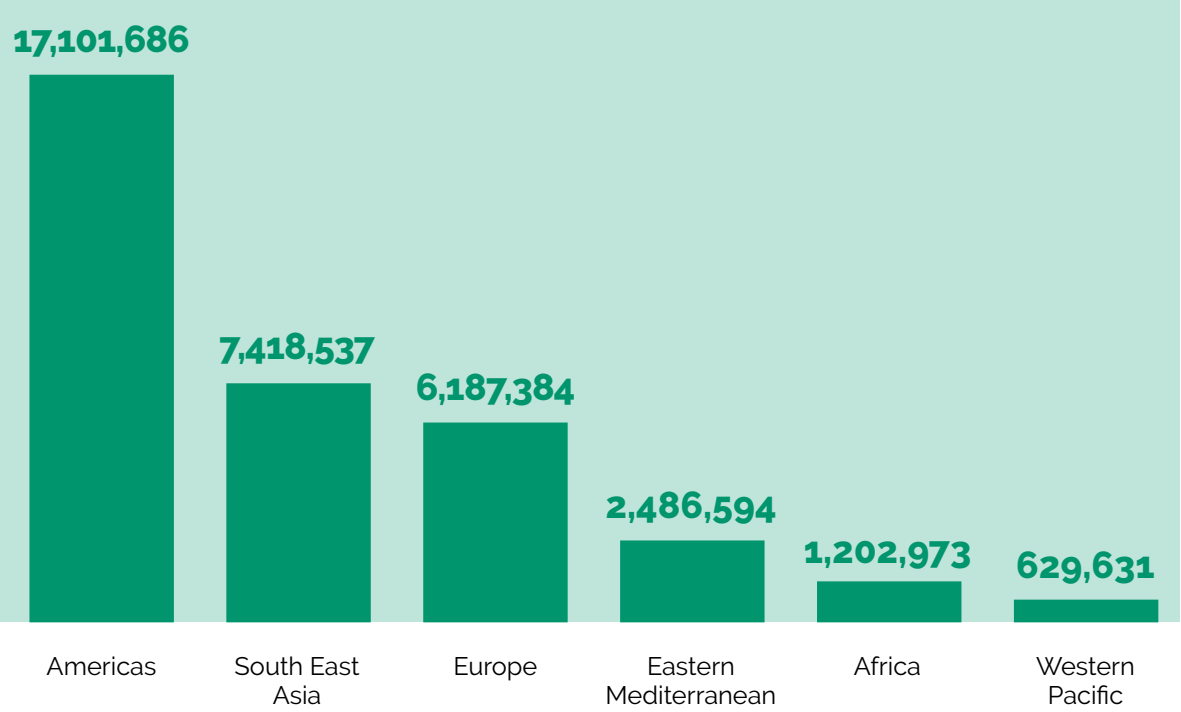
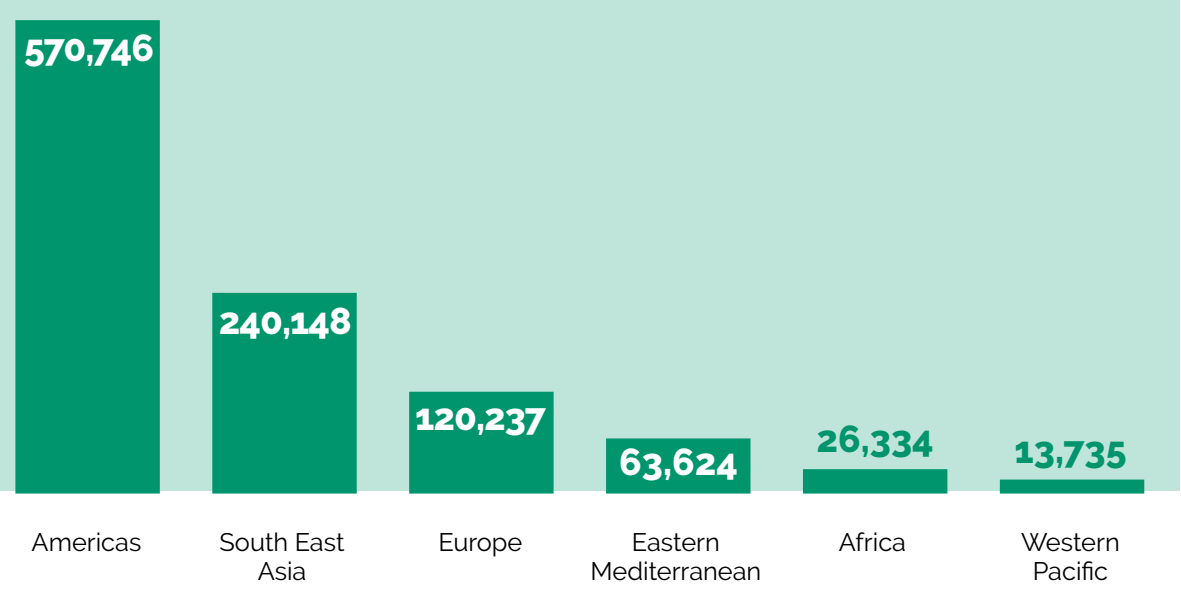


Figure 2: Deaths by region as of 5 October 2020.



The above comparisons of absolute numbers of infections and deaths should be considered with great caution, as they have very little statistical validity. Better comparisons can be made if we use the number of cases of infection or the number of deaths per 100,000 or 1,000,000 people. On the 30 May 2020, Simon de Montigny, professor of biostatistics in the Department of Social and Preventive Medicine at the Université de Montréal, Canada, told Radio-Canada that:

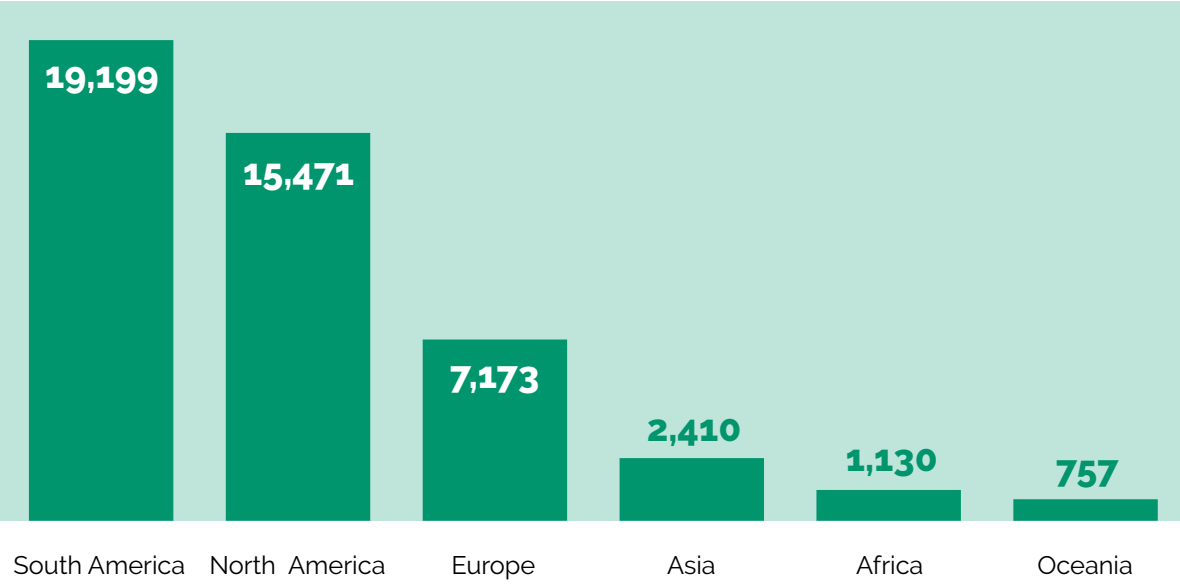
> *It is more accurate to compare the per-capita rates of infection and mortality. For example, as of 29 May 2020, Qatar has more than 53,000 cases and over 2,000 deaths. While these numbers are not nearly as impressive as the 1.5 million cases and 100,000 deaths in the United States, Qatar, with a population of less than 3 million, has a mortality rate three times higher than that of the United States.*

This exercise of comparing the number of infections or the number of deaths per 1,000,000 people demonstrates the following results on 5 October 2020 according to Worldometer:

Number of positive cases per 1,000,000 people

- South America: 19,199;
- North America: 15,471;
- Europe: 7,173;
- Asia: 2,410;
- Africa: 1,130; and
- Oceania: 757.

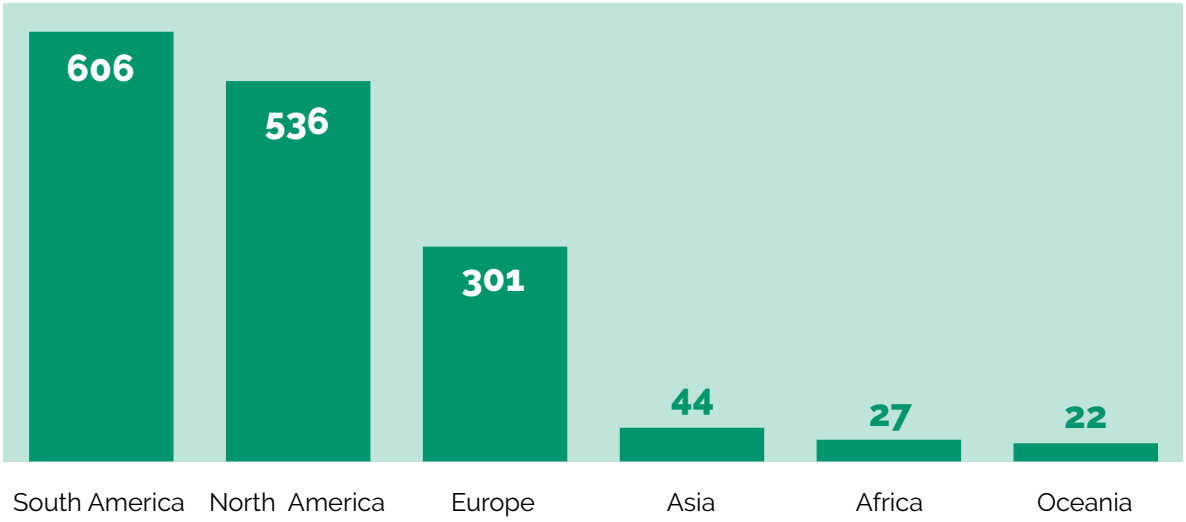
Figure 3: Cases of infection per 1,000,000 people by continent as of 5 October 2020.



Deaths per 1,000,000 people

- South America: 606;
- North America: 536;
- Europe: 301;
- Asia: 44;
- Africa: 27; and
- Oceania: 22.

Figure 4: Deaths per 1,000,000 people by continent as of 5 October 2020.



Moreover, if the data permitted, standardizing by population structure would make it possible to perform detailed comparisons, especially since it is recognized that the majority of deaths from COVID-19 are among the elderly (Mohamed et al. 2020). On the surface, populations with low proportions of elderly people would have low overall mortality from COVID-19. Let's look at the least developed regions, in particular the African continent, for which many international organizations, including WHO, predicted the worst given the fragility of the health systems in this part of the world. What could explain this low level of mortality caused by COVID-19 in Africa? Although several factors could explain the low number of COVID-19 deaths in Africa, the low age of its population appears to be the most likely explanation. Similar analyses could also be conducted by sex, as available figures indicate that men have a higher risk of death from COVID-19 than women (Wayack et al. 2020). Ultimately, because of the greater vulnerability of older people and men to COVID-19, the significant differences in population structures from one country to another affect the number of deaths (Ined 2020).

Although comparisons of the number of infections and deaths per 1,000,000 people are more meaningful than comparisons of raw numbers, questions remain as to the quality and reliability of the official numbers. We will come back to this reliability in more detail in the next section. On the 30 May 2020, Erin Strumpf, health economist at McGill University, Canada, made the following comment to Radio-Canada:

> ***The data are often imperfect and incomplete, making comparisons between countries, and even between Canadian provinces, difficult at times. Such comparisons must be made with caution, bearing in mind the problems the data present.***

In a French Institute for Demographic Studies (Ined) publication, Barbieri and colleagues discussed three key factors that could have an impact on the counts of countries and therefore on the differences observed (Ined 2020):

- place of death (home, seniors' facilities, hospitals);
- recovery time; and
- identification of the cause of death.

The COVID-19 pandemic has had and continues to have adverse effects on all industries worldwide. What impacts could this health crisis have specifically on the CRVS sector?

Effects of COVID-19 on civil registration

The universal, compulsory, continuous, permanent, and confidential nature of the registration of all vital events is undermined by the COVID-19 pandemic. A number of countries have suspended registration of certain events, such as marriages and divorces, and have revised the mechanisms for registering births, deaths, and their causes (total closure or reduction in the number of registration offices; online civil registration for countries with good internet connection, etc.) (UNSD 2020). In addition, restrictions on the movement of populations and quarantines or lockdowns in multiple countries, cities, or regions must be kept in mind.

Effects of COVID-19 on birth registration

Changes in birth registration mechanisms and the various travel restrictions have and will continue to have a definite negative impact on the quantity and possibly the quality of birth registrations (UNSD 2020) in the context of rising birth rates in some countries (Anser et al. 2020). While online registration is an option in developed countries, this is not the case in developing countries because of the poor coverage and quality of internet connections. Nine out of 10 national statistics offices in low- and middle-income countries have experienced a decline in their capacity to meet international data collection requirements, compared with 1 in 2 national statistics offices in high-income countries (Fu and Schweinfest 2020).

Morocco decided to suspend the legal deadlines for the registration of vital events, aware that the measures taken to stop the spread of the pandemic in the country could have negative impacts on the level of civil registration (L'Économiste 2020). This decision by Moroccan authorities might make it easier to catch up on civil registration once the health crisis is over.

Few countries have made these kinds of decisions, which means there will be omissions and biases in the statistics produced if no special measures are taken after the pandemic to catch up on births that were not registered because of the pandemic. The consequences of not registering these births will be dramatic for children. In the short term, the lack of a birth certificate could prevent them from accessing social services during the pandemic. In the longer term, they may not be able to register for school, access banking services, vote, etc. What makes the situation more concerning is that most of these unregistered births will be among vulnerable populations (internally displaced persons, refugees, minorities, etc.), further widening inequalities between populations (UNSD 2020).

Effects of COVID-19 on marriage registration

During the pandemic, many CRVS systems have considered marriages and divorces to be less important vital events to record than births, deaths, and causes of death (UNSD 2020). However, the suspension of marriage registration could have significant effects, such as inheritance difficulties in the event of the death of the spouse. Women and children, who are the most vulnerable in these types of situations, could suffer as a result.

Effects of COVID-19 on death registration

As in the case of birth registration, changes in death registration mechanisms and the various travel restrictions will have a definite negative impact on the quantity and quality of death registrations. The effects of not registering deaths in the civil registry are already well known. They include inheritance difficulties for beneficiaries, namely women and children, and incomplete statistics on deaths, and causes of death for planning purposes, etc.

With regard to the latter point, we note that since the outbreak of COVID-19 in Wuhan in mainland China in November 2019 and its subsequent spread to all other continents, there has been debate surrounding the accuracy of the figures provided daily by the media (confirmed COVID-19 cases and pandemic-related deaths). Doubts about the true number of deaths caused by COVID-19 appear to be partly founded. In addition, the systems for registering deaths and their causes are under strain and no longer function normally as a result of restrictions imposed by most governments, among other factors (UNSD 2020). Strategic decisions to fight the pandemic should be made on the basis of reliable data, which is not the case.

Quantifying COVID-19-related deaths: A statistical challenge

The COVID-19 pandemic has brought data to the forefront of policy development and public attention. This observation was shared by Steven Johnson in the 10 June 2020 edition of the *New York Times Magazine*: "It is true that, in the end, it is a vaccine that will protect us from SARS-CoV-2, but for now, vital statistics are the best defence we have."

To this end, there are a variety of private and public data producers reporting daily infection, death, and recovery rates. However, a proliferation of sometimes contradictory data could lead to confusion and mistrust among data users. Meanwhile, decision-makers and development partners must take swift and informed action to design interventions that reach the most vulnerable and leave no one behind (Misra et al. 2020).

At a time when everyone (primarily decision-makers) needs better information to guide evidence-based decisions and actions, there is a lack of knowledge about the true number of people who have been or are infected with COVID-19 (CCSA 2020; Ioannidis 2020). Generally, only official figures are available, and they unfortunately do not include people who are infected who do not receive a test, or those who die outside of hospitals or nursing homes (Adjiwanou et al. 2020; He and Dunn 2020; Ioannidis 2020; Misra et al. 2020). Data collected to date on the number of people infected and the progression of the pandemic are completely unreliable (Ioannidis 2020). Diagnostic tests have been very limited to date in most countries. Some deaths, and likely the vast majority of infections, from severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), may go unaccounted for (Adjiwanou et al. 2020; Dahmm 2020; He and Dunn 2020; Ioannidis 2020).

The 17 June 2020 edition of *The New York Time*s noted that at least 102,700 more people died than usual across the United States between 15 March and 23 May 2020. This number is more than 20,700 higher than the official number of coronavirus-related deaths for that period. Most of the additional deaths during that period were likely related to COVID-19, given the dangerous nature of the virus and the well-documented difficulties with reliable testing. It is also possible that deaths from other causes increased as well, as hospitals were overwhelmed with COVID-19 patients, and people with other conditions no longer visited health centres as usual.

In the 30 May 2020 edition of Radio-Canada news, Simon de Montigny, professor of biostatistics in the Department of Social and Preventive Medicine at the Université de Montréal, Canada, listed a few factors that contribute to data flaws:

> ***"There are many factors, but one reason is that the rate of testing is not necessarily the same from one location to another (because of a lack of tests or staff or for political reasons). Many infected people who have very mild symptoms do not necessarily get tested. In addition, there is no universal definition of a confirmed case. In fact, at the start of the crisis, several Canadian provinces were issuing data on probable cases (one positive test) and confirmed cases (2 confirmed tests)."***

It is also important to note that the definition of recovery varies from country to country, and even from one province to another. Some places, such as the United Kingdom, do not record the number of recoveries because of a lack of resources to track them (Radio-Canada 2020a).

Other parameters might have affected the official figures for the COVID-19 pandemic. These include variations in the time and space of methodologies, errors, and omissions.

According to the same 30 May 2020 news story on Radio-Canada News, the way cases, deaths, and tests are quantified has changed many times, leading to significant decreases or increases in the numbers. Using a few countries as examples, it stated (Radio-Canada 2020a):

- In Spain, on 16 April, serological tests were added to the total number of tests performed. One week later, the authorities changed their minds, saying the tests were not sufficiently reliable. As a result, the cumulative number of cases suddenly went from 220,000 to 200,000. Later, on 25 May, Spain decided to account for a death according to the date of death, rather than the date it was registered. The number of deaths suddenly dropped by 2,000.
- In France, data on deaths showed a sudden increase in the first weeks of April, as authorities added a number of previously unrecorded deaths. And that does not include human error.
- The Quebec government added 1,317 cases to the 3 May 2020 data in connection with a computer error in April, resulting in a huge spike in cases for that day.

In light of this proven incompleteness of the numbers, management of the COVID-19 pandemic numbers could be described as the fiasco of the century (Ioannidis 2020). The situation regarding the numbers in developing countries is worse. Many developing countries had difficulties obtaining COVID-19 test kits.

For example, despite India's efforts to accelerate its testing, as of mid-March it was still performing only 90 tests per day for a population of more than 1 billion (Dahmm 2020). Haiti performed just over 200 tests for its population of 11 million, and Venezuela likely has many more cases than what has been documented (Dahmm 2020).

Moreover, population data are integral to monitoring the impact of COVID-19 on different demographic groups, and most developing countries lack reliable census data. Without baseline data on the pandemic, countries will not be able to develop informed responses (Dahmm 2020). The following were among the 12 unanswered questions about COVID-19 asked on 20 June 2020, (Radio-Canada 2020b):

- How many people have been infected?
- What is the case fatality rate for COVID-19?
- Can we rely on serological tests?

This fiasco with the pandemic numbers creates enormous uncertainty about the risk of death from COVID-19. The official WHO case fatality rate of 3.4 percent is meaningless in these circumstances (Ioannidis 2020). The most valuable information for answering these questions on fatality would be to determine the actual prevalence of infection in a random, representative sample of a population and to repeat this exercise at regular intervals to estimate the incidence of new infections (Ioannidis 2020). At minimum, unbiased prevalence and incidence data are essential for monitoring changes in the infection load to guide decision-making (Ioannidis 2020). In the absence of measuring the prevalence of infection in a random, representative sample of the population, strategies are needed to assess the quality of official data. To do this, it is important to use all reasonable sources of data to make an accurate assessment of the number of cases and the impact of the pandemic (He and Dunn 2020).

Using Wuhan, the first epicentre of the COVID-19 pandemic, as an example, He and Dunn compared official and unofficial data (operations of cremation facilities in Wuhan) (He and Dunn 2020). They found the numbers of cumulative cases, new cases per day, and cumulative deaths from unofficial data were considerably higher by a factor of 5 to 10 (depending on the date of the data) than the Chinese government's official data would suggest. While official figures from the Chinese government indicated a case fatality rate of less than 5 percent in early January 2020, unofficial sources predicted a case fatality rate of at least 10 percent for the same period (He and Dunn 2020). While there are significant reporting errors in the unofficial data, the magnitude of the discrepancy between the results of their analysis and the official figures suggests the need for a serious re-evaluation of all that is known about the current pandemic. For the world to respond to this global humanitarian crisis, no credible data source should be ignored (He and Dunn 2020).

In high-income countries, CRVS systems generally address the issue of deaths being underreported within a short time. They record deaths from all causes, regardless of where they occur. This makes it possible to calculate "excess mortality," meaning the number of additional deaths compared to a recent past before the COVID-19 pandemic (Adjiwanou et al. 2020). However, in low- and middle-income countries, CRVS systems are not functioning normally to fill gaps in COVID-19 mortality data. The issue of quantifying deaths from COVID-19 is therefore worse in developing countries. In normal circumstances, the WHO estimates that more than two-thirds of deaths are not registered, and data collected on deaths are generally of poor quality and very often lack an identification of the cause of death. Consequently, thousands of COVID-19-related deaths may be missing from official counts (Dahmm 2020).

The perennial question of identifying the real cause of death

Within five months (January to May 2020), COVID-19 went from being the 19th cause of death in the world to the number 1 cause (Nickonchuk 2020). However, does this mean all deaths caused by COVID-19 have been classified as such? The identification of the cause of death is an essential component of all properly functioning CRVS systems. The rate of mortality by cause is a critical factor in decision-making and planning of population health interventions (De Savigny et al. 2017; Lozano et al. 2012). In this time of the COVID-19 pandemic, one of the key questions is to determine how many people are dying from COVID-19. There is an immediate need for reliable data on this subject to determine the urgent actions to be taken (Setel et al. 2020). However, even once the pandemic has ended, we may never know objectively how many people died from COVID-19 (UNESCAP 2020a). Identifying COVID-19 as the cause of death appears to be challenging for many certifiers, given the many questions that have been raised in this area (National Vital Statistics System 2020).

In its 30 May 2020 edition, Radio-Canada news asked who is dying from COVID-19 (Radio-Canada 2020a). The answers were as follows:

- In New York State, at the beginning of the pandemic, a positive test was required to confirm COVID-19 as the cause of death. Now, seniors in long-term care facilities who are presumed to have died of COVID-19 are counted, even without a test;
- In the United States, the Centers for Disease Control and Prevention observed a significant increase in pneumonia deaths in March. While the authorities suspect COVID-19 was the cause, these deaths were not added to the official count; and
- The lack of testing in many parts of the world means doctors cannot indicate on the death certificate whether or not the person died of COVID-19, leaving it open to interpretation. Autopsies to determine whether COVID-19 was the cause of death are relatively rare.

Nevertheless, the starting point for understanding the impact of COVID-19 is to ensure physicians are properly trained in diagnosing this condition through laboratory or clinical findings so they can provide appropriate treatment, plan resources, and report this new virus on the declaration of death (UNESCAP 2020a). In the absence of laboratory or clinical findings, the Data for Health Initiative produced a video to help physicians and data coders accurately code and certify deaths caused by COVID-19.

This death certification support video is an alternative solution in times of health crisis such as these. When health systems are already overwhelmed, they may not have the capacity to disseminate evolving COVID-19 case definitions to all clinicians, and physicians may not report deaths according to WHO recommendations (UNESCAP 2020a). Furthermore, research has shown that considerable misclassification occurs, even when hospital data are the main source of information on deaths and causes of death are recorded. Universal testing has not yet been performed, and given the overlap with the influenza season, deaths from COVID-19 may be misclassified as other severe acute respiratory deaths (UNESCAP 2020a). Moreover, attributing cause of death is even more complicated in elderly people with morbid conditions (UNESCAP 2020a).

This issue of comorbidity must be discussed. There are three main determinants of COVID-19 (Lippi et al. 2020). These are sex (male), age (population over 60 years old), and pre-existing comorbidities, such as diabetes, hypertension, chronic respiratory diseases, cancer, and cardiovascular disorders. Most people who have died from COVID-19 had other chronic diseases. Barton et al. performed autopsies on two men, aged 77 and 42, who died of COVID-19 in Oklahoma in the United States. They confirmed death from COVID-19 and found both individuals were obese and had pre-existing conditions, such as hypertension (Barton et al. 2020).

In some people who die of viral respiratory pathogens, more than one virus is detected at autopsy, and bacteria are often present as well. Deaths among people with type 1 or type 2 diabetes increased sharply in England at the start of the COVID-19 pandemic. The increased mortality associated with COVID-19 was linked not only with the cardiovascular and renal complications of diabetes but also, independently, with blood glucose problems, and body mass index (Holman et al. 2020). A positive test for COVID-19 therefore does not necessarily mean the virus is always the primary cause of a patient's death (Ioannidis 2020).

While high-income countries have relatively well-functioning CRVS systems and are rapidly implementing measures to record all COVID-19-related deaths according to international standards, CRVS systems in low- and middle-income countries continue to suffer from weaknesses in registering deaths, collecting causes of death, and producing vital statistics (UNESCAP 2020a). While there may be quick alternatives for registering deaths and determining their causes in developed countries, the situation is quite different in developing countries. In Asia and the Pacific, for example, at least 5 in 7 deaths are not registered, and the causes will remain unknown (UNESCAP 2020a). The combination of poor health surveillance systems and the failure by health systems to systematically record causes of death is and will be responsible for the number of deaths from COVID-19 being underreported. During the current acute surveillance period, these systems are unable to detect all new cases and deaths. This means the region will have an incomplete measurement of the mortality burden from COVID-19 at the end of the pandemic (UNESCAP 2020a).

The COVID-19 pandemic has and will have major adverse effects on the operations of CRVS systems around the world, particularly in developing countries. But how have CRVS systems fared in the face of this crisis? Have they been resilient?

Maintaining civil registration and vital statistics during the COVID-19 pandemic

The United Nations Legal Identity Task Force conducted a short survey of CRVS systems, namely to:

- assess the impact of COVID-19 on their functioning;
- document national solutions to contextual challenges hindering the smooth conduct of vital registration and statistical production activities during the pandemic; and
- share the experiences of various CRVS systems to adopt good practices.

A total of four fundamental questions were asked:

- Is civil registration considered an essential service in your country?
- What are the impacts of COVID-19 on the registration of vital events in particular and on the functionality of CRVS systems in general?
- What adjustments are being implemented or planned during this pandemic period to ensure the continuity of operations?
- What recommendations have been issued to civil registry offices to ensure that all births, deaths, marriages, and other vital events are registered during this period?

Most countries that participated in this United Nations survey on the continuity of CRVS systems during the pandemic indicated operations of CRVS systems were considered essential services for their countries and adjustments should be made to maintain civil registration during the pandemic. Based on the survey results, and to assist CRVS systems in maintaining their operations during the pandemic, recommendations were issued to the civil registration

authorities to ensure operational continuity during COVID-19. These recommendations were issued by the United Nations Legal Identity Task Force with the support and contributions of, among others, the United Nations Economic Commission for Africa and the United Nations Economic and Social Commission for Asia and the Pacific.

Among other things, these recommendations state that:

- **During national emergencies such as COVID-19, CRVS systems' operations should be maintained** to continue the registration of births, deaths (including causes of death), and other vital events, and ensure the production of accurate statistics on births and deaths.
- **The continuation of these activities contributes to the fight against the pandemic and mitigates its negative impacts.** An individual's legal identity remains of crucial importance during public health emergencies. Individuals need to be able to prove their identity to access public services such as health care, humanitarian assistance, financial aid, and other social services. Children who are not registered at birth because of disruptions, such as the current COVID-19 pandemic, are particularly vulnerable. Unregistered, "invisible" children may be at increased risk of violence, trafficking, etc. These risks are known to increase during such events. These individuals may carry this disadvantage for years, as delays in registration processes and challenges in demonstrating proof of birth may result in ongoing barriers once the health situation improves. In addition, data collected are invaluable sources of key information needed to formulate a national policy response during and after the health crisis.
- **Civil registration must be considered an "essential service" mandated to continue operations during a pandemic** by making certain arrangements, such as
  - adjusting hours of operation;
  - promoting online registration;
  - temporarily suspending certain registration processes, such as legitimations;
  - waiving fees for late registrations;
  - raising public awareness;
  - protecting staff; and
  - interacting with other government departments, etc.

A guidance note should be developed for various adjustments to inform all actors of the operational procedures, which will generally differ by context.

Beyond these general recommendations of the United Nations Legal Identity Task Force, many countries have adopted different endogenous solutions to adapt to or mitigate the effects of COVID-19 on their CRVS systems' operations. More details on these recommendations can be found in the document, Maintaining Civil Registration and Vital Statistics during the COVID-19 Pandemic (UN 2020).

Despite the obvious willingness to adapt CRVS systems to the health crisis, it appears these systems are unable to provide reliable real-time data necessary for decision-making in their current format and functionality,

Workarounds for the inability of CRVS systems to provide accurate and complete real-time information

Conventional CRVS systems: A mechanism ill-suited for real-time information

The COVID-19 pandemic has revealed once again that the current functioning of CRVS systems around the world does not make it possible to meet the urgent need for reliable data during times of crisis. In France, for example, the National Institute of Statistics and Economic Studies and the National Institute for Health and Medical Research are working to produce the statistics needed to monitor the health situation over time. However, it is difficult for them to respond in real time to questions raised by the pandemic, as public statistics are based in an administrative tradition in which production times are not very compatible with urgency (Pison and Meslé 2020). Continuing with the example of France, if a medical certificate is submitted in paper form (in 2019, 88 percent of the certificates containing the causes of death in France were submitted in paper form), the cause of death is unavailable for processing until three weeks to four months after the death (Pison and Meslé 2020).

The heat wave of August 2003 led to excess mortality of nearly 15,000 deaths in France over 10 days, primarily among the elderly. However, the number of deaths was not known until long after. It was the frontline professionals who signalled the sudden increase in deaths: emergency physicians, who were overwhelmed, and funeral parlours, which ran out of coffins. This was a revelation. At the time, public statistics were not organized to make it possible to monitor epidemics or disasters in real time. After the heat wave, public statistics had to be adapted to provide up-to-date figures, without waiting for annual or monthly reports. It was decided to implement or accelerate the electronic completion and transmission of documents. By accelerating procedures, as is the case with the COVID-19 pandemic, the National Institute of Statistics and Economic Studies is able to estimate the daily number of deaths in each department seven days later, at the earliest (Pison and Meslé 2020). We consider this to be a long delay, given the decision-making urgency the pandemic requires.

The conventional statistical system is therefore poorly adapted to providing real-time information on mortality, even when it mobilizes as it has during the COVID-19 pandemic. That is why alternative sources or methods are needed. In France, the Système d'information pour le suivi des victimes d'attentats et de situations sanitaires exceptionnelles (SI-VIC), or information system for monitoring victims of attacks and exceptional health situations, established after the 2015 Paris attacks, has become the main source of daily death counts from COVID-19 communicated by the health authorities. However, the figure was incomplete in the early stages, because only deaths that had occurred in a hospital were counted, and not those at home or in a nursing home. SI-VIC is a project initiated by the Ministry of Health, which delegated its management to the Agence du numérique en santé, or Digital Health Agency. SI-VIC can be used to access and update information on the identity of the patient under care, the patient's care (hospital or medical/psychological), and emergency contact (Pison and Meslé 2020).

According to Tom Moultrie, demographer at the University of Cape Town, "some countries, such as South Africa, have begun to implement real-time mortality surveillance systems, but accuracy

is impeded by delays in reporting deaths, a lack of information on causes of death, and poor-quality data on the place of death or residence, which limits our ability to track 'hot spots' in near real time" (Dahmm 2020).

The statistical system is ultimately subjected to two contradictory directives: to generate accurate and complete information, and to provide it in real time. Urgency and statistics have historically not been a good match. Nevertheless, we must not give up on developing emergency statistics to be used for public decision-making and informing citizens (Misra et al. 2020; Pison and Meslé 2020). At a time when statistics are most needed, many statistical systems are struggling to compile baseline statistics, again highlighting the need for investment in data and statistics, and the importance of having modern national statistical systems and data infrastructure (CCSA 2020). This modernization of statistical systems could be achieved through the use of data from new information and communication technologies.

Use of mobile and satellite data and other metadata as alternative solutions

The COVID-19 pandemic has highlighted the importance of the digital revolution, while opening up new opportunities to strengthen and modernize the baseline data collection programs of national statistical systems (Fu and Schweinfest 2020). For effective and rapid decision-making at all stages of the pandemic, reliable data are needed on the infection and on human behaviour, particularly on mobility and physical co-presence of people (Oliver et al. 2020). Previous work has shown mobile phone data could help model the geographic spread of epidemics (Bengtsson et al. 2015; Finger et al. 2016; Tizzoni et al. 2014; Wesolowski et al. 2012; Wesolowski et al. 2015).

To this end, some European authorities (including in Austria, Belgium, France, Germany, Italy, and Spain) are working with researchers and mobile network operators either to understand compliance with and the impact of the social distancing measures implemented to combat the COVID-19 pandemic, or to identify and predict potential disease hot spots or estimate the effectiveness of travel restrictions (Adjiwanou et al. 2020; Adnkronos 2020; El País 2020; Pepe et al. 2020).

In China, data from Baidu were used to assess how the quarantine of Wuhan affected the spread of the virus (Kraemer et al. 2020; Lai et al. 2020). Using the city of Boston (United States) as a test case, researchers aggregated location data from over 180 applications to propose specific day-to-day social distancing measures to be implemented and establish projections of the effects of different policies on the spread of COVID-19 (Martín-Calvo et al. 2020). In the race to contain the spread of this highly transmissible virus, countries that rapidly deployed digital technologies to facilitate planning, surveillance, testing, contact tracing, quarantine, and clinical management have remained at the forefront of managing the disease burden (Whitelaw et al. 2020).

All of the approaches described above are either national or regional in scope. There is unfortunately no coordination or information exchange between national or even regional initiatives at this time (Buckee et al. 2020). Although ad hoc mechanisms can be developed effectively at the local or national level, regional or even global collaborations seem almost impossible, given the number of actors, differences in interests and priorities, diversity of the legislation involved, and need to protect civil liberties (Oliver et al. 2020). Nevertheless, the global scale and spread of the COVID-19 pandemic underscore the need for a more harmonized or coordinated approach.

In light of the above, there is unanimity on the invaluable contribution of mobile phones in the fight against the pandemic, but there is still little strategic and systematic use of these alternative data sources in the COVID-19 response (Oliver et al. 2020). What explains this reluctance and/or failure by many governments around the world to use this approach? There are five main reasons (Oliver et al. 2020):

- Lack of awareness by governments and authorities about the potential of mobile phone data to help in the fight against the pandemic;
- Access to the data;
- Concerns about privacy and data protection;
- Subjectivity by researchers who often approach the problem from their own perspective, without considering the needs of governments and decision-makers; and
- Lack of readiness to take immediate and rapid action.

To overcome these five obstacles, Oliver et al. make a few recommendations to enhance the use of mobile phone data to combat the pandemic (Oliver et al. 2020). To facilitate the effective development of the best, most recent, relevant, and actionable knowledge, the authors encourage governments, mobile network operators, and researchers to form joint teams.

- **Governments should be aware of the value of the information and knowledge that can be generated from analyzing mobile phone data**, particularly for objective targeting and monitoring of measures needed to contain the pandemic. They should facilitate the equitable and responsible provision and use of aggregated and anonymized data for this purpose.
- **Mobile network operators should accept their social responsibility** and the vital role they can play in the fight against the pandemic.
- **Researchers and experts in the field should recognize the interdisciplinarity and context-specific considerations and sensitivities** (such as virologists, epidemiologists, demographers, statisticians, computer scientists, and social scientists). They need to involve governments from the outset and throughout their efforts to identify the most relevant issues and knowledge needs. The creation of multidisciplinary, inter-institutional teams is of paramount importance.
- **Personal data protection authorities and civil liberties advocates should also be involved** early on, in a transparent manner, and in rapid iteration cycles.
- **International discussions should include other experts in the field and with other initiatives and groups** to share results promptly. There will be time for scientific publications. Particularly in countries with weaker health systems, the identification and efficacy of non-pharmaceutical interventions could make a big difference. In addition to international discussions, there is also a need for international approaches coordinated by supranational bodies. National initiatives could help to some extent but will not be sufficient in the long term. A global pandemic requires coordinated work at the global, or at least regional, level.

In the specific case of less-developed countries, it must be noted that the universal registration of deaths and their causes was ineffective in most of these countries, even before the COVID-19 pandemic. Yet, in the future, this universal registration of deaths will be essential to strengthen responses to pandemics. In the short term, interim tools are needed to assess excess mortality from COVID-19 in developing countries. Surveys and censuses, which are the main sources

of mortality data in most developing countries, are unsuitable for this exercise, as they are cumbersome operations in terms of time and financial and human resources (Adjiwanou et al. 2020). Rapid mobile phone surveys to measure mortality trends on a monthly basis are a realistic and secure option to fill this data gap (Adjiwanou et al. 2020; Fu and Schweinfest 2020). To carry out this data collection by telephone or, later on, by online data collection, there is an urgent need to invest in national statistical systems in the least-developed countries to compensate for technology and infrastructure gaps (Fu and Schweinfest 2020).

The effects of COVID-19 on the operations of CRVS systems should be documented, but it is also important to think about CRVS systems after COVID-19. What CRVS systems will we want to have after the COVID-19 pandemic?

CRVS systems after COVID-19: concerns and opportunities

Recall that many vital events could not be recorded as a result of the pandemic. In our opinion, the first critical activity of CRVS systems after the COVID-19 crisis would be to catch up on the registration of all vital events that were not recorded because of the pandemic. This will thus mitigate the negative effects of COVID-19 on the operations of CRVS systems and help maintain the continuous, permanent, compulsory, and comprehensive nature of civil registration. While developed countries will be able to catch up quickly because of the good quality of their CRVS systems, the situation is quite different in developing countries. For these less-developed countries, new strategies are needed to record vital events that could not be registered because of the pandemic.

In addition to catching up on civil registration, it is also important to consolidate statistics, particularly those related to causes of death. Thus, two major challenges are to determine how to estimate the extent of underreported deaths from COVID-19 and the actual number of deaths. To do this, for example, it is possible to calculate excess mortality for the various causes: the number of excess deaths from individual causes in 2020 compared with previous years.

One option to consider would be to compare trends in death rates and causes of death over the past five years. For each country, results would be disaggregated by region, age group, sex, month of death, etc. We could hypothesize that, all else being equal, mortality rates and causes of death have not been fundamentally different for the last five years (2016–2020), particularly for 2019 and 2020. Excess mortality from the broad respiratory diseases group that will likely be evident in 2020 (compared to 2019) could be attributed to COVID-19 under certain assumptions, as the COVID-19 pandemic could also cause excess mortality from other causes of death. According to the European Mortality Monitoring Project (EuroMOMO), in March and April 2020, there were at least 149,000 more deaths than those recorded in Europe for the same period in previous years, a figure much higher than the official cumulative death toll from COVID-19 (Radio-Canada 2020a; The New Humanitarian 2020).

While the activities of catching up on and consolidating vital statistics are taking place, solutions for strengthening the operational capacity of CRVS systems will need to be considered. The crisis linked to the COVID-19 pandemic has highlighted the need to adjust our civil registration systems. CRVS systems should be modernized to provide the real-time statistics that governments need for better policy planning in the future. The strengthening of CRVS systems after the pandemic is therefore non-negotiable to facilitate the production of accurate statistics on causes of death, for example (UNESCAP 2020a).

In the future, it will also be necessary to increase collaboration between different actors (researchers, governments, private-sector actors such as mobile phone operators, health systems, etc.). The current global health emergency underscores the need for effective CRVS systems and interoperability with health systems in particular. Ensuring that every death is registered and that all causes of death are accurately recorded will improve mortality statistics and facilitate health policy development (UNESCAP 2020a).

Among the solutions for strengthening the operational capacity of CRVS systems, consideration should be given to mechanisms that maximize the digitization of activities, as noted above. There is often enthusiasm for the use of metadata (mobile data, satellite data, etc.) at the height of pandemics, but there is limited use of these opportunities in pandemic responses and during and after the pandemic. This was the case for Ebola (The Economist 2014; McDonald 2016). While the solution of using mobile data is very promising in Western countries, this is a challenge in most developing countries, where internet access is still considerably limited and mobile phone ownership is much less reliable than in developed countries (Dahmm 2020). Therefore, strengthening CRVS systems in these countries requires significant investment.

However, another concern remains; namely the ordinary difficulties of investing in national statistical systems, which will be exacerbated by this crisis. Partnership in Statistics for Development in the 21st Century (PARIS21) reports that currently only 0.33 percent of public development aid is allocated to statistics. With COVID-19, this chronic under-investment could be exacerbated for a number of reasons: the economies of the countries contributing to development aid are also hard hit by the crisis, and the limited funds that could be allocated to development aid could be directed primarily to health systems, which have shown their weaknesses during the COVID-19 pandemic.

The global statistical community and donors must urgently provide technical assistance and financial resources to the national statistics offices that need help the most. According to figures from the United Nations Statistics Division of the Department of Economic and Social Affairs, 9 out of 10 national statistics offices in low- and middle-income countries have or have had difficulty functioning during the pandemic because of funding constraints, as more than half of these structures have seen funding cuts (Fu and Schweinfest 2020). According to the same figures, 61 percent of national statistics offices report the need for additional external support to meet the challenges associated with the COVID-19 pandemic. Priority areas for support in this group of countries include technical assistance, capacity building, financial support, and remote data collection software (Fu and Schweinfest 2020). In addition to the need for funding for resilient CRVS systems, increased investment in national statistical systems is a critical factor in supporting post-pandemic socio-economic recovery (UNESCAP 2020b).

Currently, most COVID-19-related analyses are performed in aggregate. However, it is recognized that there are disparities by age and sex. In the next section, we focus on the relationship between COVID-19 and gender.

Gender and COVID-19

Researchers and decision-makers should examine how COVID-19 disproportionately affects women and girls (Evans 2020; Kim et al. 2020). When we talk about a crisis, it is absolutely vital that we understand how it affects communities, especially those that already have heightened vulnerabilities or marginalizing characteristics, such as women (Malik and Nakeem 2020). Documenting gender disparities in the COVID-19 pandemic is a fundamental step in understanding the effects of the health crisis on different groups of people and will thus facilitate the implementation of effective and equitable policies and responses (Wenham et al. 2020). Medical technology and resources to respond to the pandemic should be produced and distributed equitably, considering differences in vulnerability and sensitivity (Kim et al. 2020). Gender inequalities could become even more pronounced during health emergencies, as is currently the case with COVID-19 (Evans 2020; Ryan and El Ayadi 2020).

However, according to available morbidity and mortality figures on COVID-19, the pandemic affects men more than women in most countries. It is true that more men die from the disease than women (Buvinic et al. 2020; Mohamed et al. 2020). But does this statistic of excess mortality among men hide other types of vulnerabilities resulting from the pandemic that may disproportionately affect women? While there is a lack of fine-grained data disaggregated by sex and age in almost all countries around the world, and particularly in less-developed regions (Buvinic et al. 2020), it is recognized that women generally appear to be more vulnerable on many levels as a result of the pandemic (Wenham et al. 2020).

This vulnerability of women is attributable to the various restrictions imposed by governments. Recall that these measures range from the closure of workplaces to the shutdown of transit, closing of schools, travel restrictions, and the strict lockdown of populations. Access to reproductive, maternal, and child health care has been particularly affected.

In addition to the restrictive measures taken by governments, there is the reallocation of resources for the COVID-19 health emergency and consequently an overall decrease in resources allocated to other areas of health. This results in an increase in unintended pregnancies and in maternal and infant morbidity and mortality (Evans 2020).

According to BBC News Africa on 19 June 2020, the Kenyan government confirmed that there had been a significant increase in adolescent pregnancies, especially since the COVID-19 restrictions began in March. The actual numbers are likely to be much higher in the country, as adolescent pregnancies are often underreported. In addition, because of school closures and thus the removal of institutional protections, adolescent girls and young women are particularly vulnerable to the many consequences (Buvinic et al. 2020). The Global Director of the World Bank's Gender Group, Caren Grown, made the following appeal in an interview on 15 May 2020: "In this COVID-19 pandemic situation, it is even more imperative to provide the services that women need, especially the front-line health services that they may require, such as maternal and reproductive health services."

Certain groups of women appear to be particularly vulnerable during this crisis. The fatality rate of COVID-19 in Iran was much higher in pregnant women than in other population subgroups (Hantoushzadeh et al. 2020). In fact, out of nine women who tested positive for COVID-19 in their second or third trimester, seven died. Compared to their relatives or contacts who were infected by the disease, the fatality rate among pregnant women was therefore very high.

We are also seeing a decline in the number of assisted deliveries in some countries as a result of the COVID-19 pandemic (Davis-Floyd et al. 2020; Romanis and Nelson 2020), all of which makes this subgroup of women even more vulnerable. Paid female caregivers are on the frontlines of health crises. Making up 70 percent of the world's healthcare workforce, women are in close contact with patients and therefore face a higher risk of infection. Women also provide most unpaid care work. Overall, women do an average of three times as much unpaid care and domestic work as men a workload that increases with school closures and overburdened health systems (Buvinic et al. 2020; CCSA 2020).

Periods of economic, health, and social crises and disasters have always been a risk factor for increased violence against women and children. The COVID-19 health crisis is no exception. The various measures taken by governments, such as quarantines, lockdowns, and social isolation, with their consequences of economic insecurity and poverty-related stress, have exacerbated domestic violence (Peterman et al. 2020; Wenham et al. 2020). New data confirm that violence against women and girls has increased since the start of the pandemic, resulting in a shadow pandemic (CCSA 2020; Malik and Naeem 2020).

In terms of employment, it should be noted that in high-income countries, where the pandemic has been more severe, job losses appear to affect women's earnings disproportionately. In the United States, for example, women accounted for 50 percent of payroll jobs in February, but 58.8 percent of job losses in March (Gould et al. 2020). Widespread job losses among women will have long-term effects on women's economic independence and security. With 740 million women in the world working in the informal sector, mostly in services, women are particularly affected by the crisis with respect to partial or total unemployment (CCSA 2020).

In light of the above, it is clear that the effects of the COVID-19 pandemic are and will continue to be a threat to the fragile gains in gender equality and women's rights. Sex-disaggregated statistics are essential to examine the differential impact on women and men to support evidence-based decision-making.

Conclusion

The COVID-19 pandemic has exposed the shortcomings of CRVS systems around the world in terms of their functionality during health crises and other natural disasters. All of the literature on this health crisis comes as a call to reflect on the weaknesses of current CRVS systems to propose solutions for enhanced capabilities to provide reliable vital statistics in real time for informed decision-making.

This literature review provided an overview of strategies for adapting CRVS systems in times of crisis. We have documented possible avenues for catching up on and consolidating vital statistics. This work has also made it possible to propose solutions for effective and efficient CRVS systems in the future. Among these proposals, maximizing the digitization of CRVS systems' activities seems to be the most promising avenue. This digitization will help CRVS systems to be better prepared and resilient in the likely event of future crises.

However, given that CRVS systems are not all at the same level of development, there will objectively be differences in the ways that countries adapt to the social, economic, and health impacts of the pandemic as a result, among other things, of differences in economic potential and the scale of needs. Developed countries will find it easier to cope with the consequences of this health crisis on their CRVS systems (Fu and Schweinfest 2020). In addition to overcoming the adverse effects of this crisis, these developed countries will have the option of digitizing all of the activities of their CRVS systems in record time.

Conversely, the least-developed countries are simultaneously facing the pre-pandemic challenges of operationalizing their CRVS systems (low coverage of civil registration, lack of funding, etc.) and the new challenges related to COVID-19 (Fu and Schweinfest 2020). The least-developed countries face significant challenges to modernizing their CRVS systems.

Nevertheless, with regard to the challenge of having reliable real-time data in the future, there is a need for proactive policy from national and international authorities to ensure adequate funding for CRVS systems so that they can be modernized for greater resilience to future disasters.

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